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Timber Damage by Black Bears

Approaches to Control the Problem

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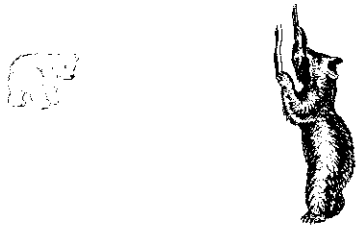

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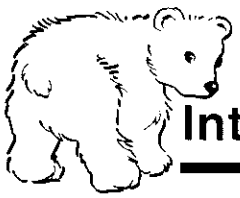
Contents



Introduction

When black bears (figure 1) emerge from their winter dens, foods are relatively scarce. Because trees are already producing sugars (carbohydrates) during the early spring, bears strip the bark and eat the newly formed wood underneath.

Figure 1—Black bears strip the bark from trees to eat the sapwood.

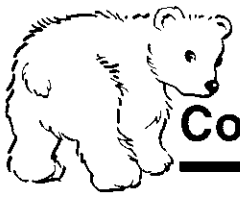
Bears have caused significant damage to some stands of timber, particularly in the Pacific Northwest. This report considers why bears cause such damage and what managers can do to reduce the damage. Sugar concentrations vary, depending on the tree species and the season. For instance, bears generally forage on hemlock before Douglas-fir, which probably reflects an earlier flush of nutrients in the hemlocks. Similarly, bears may have sampled a tree early in the spring, only to return a few weeks later and strip it, presumably when sugar concentrations are greater.

Bears use their claws to strip bark from a tree, then feed on the sapwood (newly formed outer wood) by scraping it from the heartwood (older central wood) with their teeth. Scattered remnants of bark strewn at the base of a tree and vertical tooth marks indicate bear activity. Occasionally a tree will be "frilled," with bark strips loosened at the base and pulled up away from the tree. These strips may hang from more than 5 meters up on some trees, such as western red cedar.

Bears usually forage on the lower trunk of trees, girdling the bottom 1 to 1.5 meters. Some bears may climb the tree and sit on branches to feed higher up. Bears have been known to strip entire trees. Damage within a stand can be extensive. A single bear can strip bark from as many as 70 trees per day.

Stripping trees for food is different than marking trees to stake out territory. "Bear trees" are rubbed and scent-marked by both sexes, especially by adult males before and during the mating season. Marks are usually made by biting or clawing conifer or deciduous trees about 1.5 to 2 meters above the ground. Although marked trees are common in most areas where black bears are found, damage caused by marking is not severe.

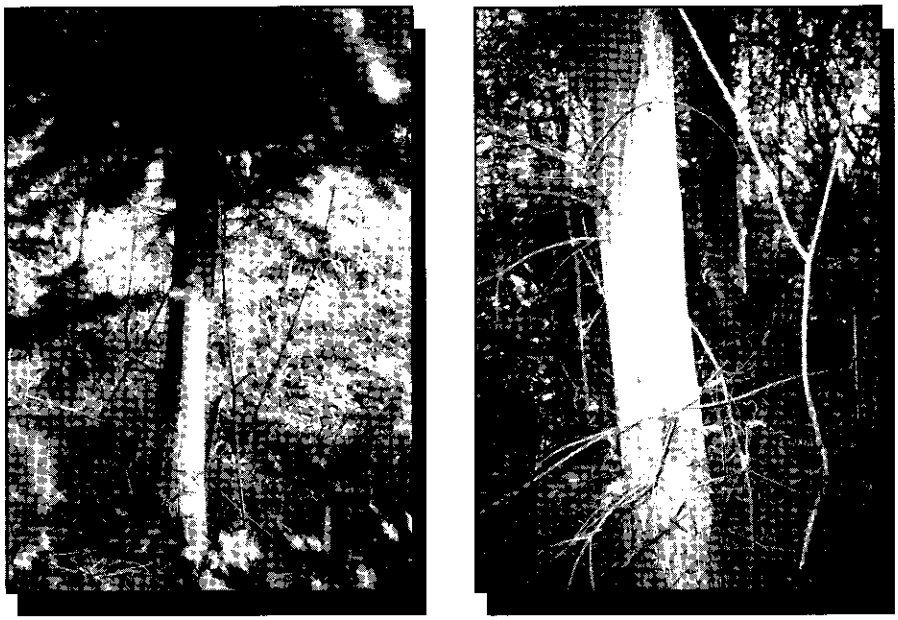
Tree species stripped by bears vary depending on the location, probably reflecting the species available. In the Pacific Northwest, bears frequently girdle (strip bark all the way around the trunk) of Douglas-firs, primarily immature smooth-barked trees ranging from 15 to 30 years old. Girdled trees die because they cannot transport nutrients from the branches to the roots. Trees of any age are vulnerable to bear damage. Although western hemlocks are sometimes stripped, they are stripped earlier in the year and are stripped less frequently once Douglas-fir trees break dormancy. Bears appear to prefer redwoods in northern California, western red cedar in British Columbia, and western larch in interior forests. Other species reported to have been stripped by bears include silver fir, balsam fir, grand fir, subalpine fir, noble fir, bigleaf maple, red alder, western larch, Port Orford cedar, Engelmann spruce, white spruce, red spruce, Sitka spruce, whitebark pine, lodgepole pine, western white pine, aspen, black cottonwood, bitter cherry, willow, and northern white cedar.



Consequences of Bear Damage

When bears strip trees (figures 2a and 2b), they can harm the health of a stand or a particular species within the stand. Complete girdling is lethal. Partial girdling slows a tree's growth and increases the likelihood of insect and disease infestations. Bears often strip the most vigorous trees. Damage frequently occurs after stand improvements, such as thinning.

While bear damage occurs nationally, damage occurs frequently in the Pacific Northwest. Whether the damage reflects improved stands with just one timber species, decreased alternative forage, behaviors that offspring have learned from their mothers, or increased bear populations is largely unknown. All of these causes probably play some role. Stand improvements have increased the palatability and nutritional content of the trees. Cubs that eat the sapwood of trees stripped by their mother will probably continue stripping trees when the cubs are adults.



Figures 2a and 2b—Douglas-fir trees peeled by a black bear feeding on sugars in the newly formed wood beneath the bark.

Damage Management

Three primary options are available to reduce bear damage:

- Eliminate or remove the problem animals or reduce the overall bear population.
- Apply silvicultural practices that minimize the attractiveness and vulnerability of the trees.
- Provide an artificial alternative food source during the spring.

The appropriate approach depends on management objectives and site characteristics. A damage management plan may incorporate more than one of the approaches. Other nonlethal approaches (such as devices to frighten bears, fences, or repellents) can be considered, but are generally impractical for large forest stands.

Bear Removal

Historically, bears were killed to protect timber resources from bear damage. Animal damage control agents or professional hunters were hired to trap and hunt bears in areas where damage was occurring. Although regulations governing control measures have changed, professional agents are still effective in removing problem animals. Aldrich foot snares permit agents to target bears in specific areas. Trained hounds also can be used to locate problem bears. Depredation hunts may be used to remove problem animals.

Recreational hunting can be used to suppress bear populations. Special bear hunts have been authorized in some high-damage areas. Hunters can be encouraged to hunt in areas where tree stands are most vulnerable to bear damage. In such cases, maps of specific bear-damage areas can assist sport hunters. Master hunter programs provide additional training for hunters. Graduates of such programs provide a pool of ethical and knowledgeable hunters for use in sensitive damage-control situations such as these.

The general public would often prefer that bears be moved rather than killed. Moving bears is generally impractical. Few, if any, unoccupied favorable sites exist where bears will not cause similar problems. Furthermore, once bears have learned to strip trees, moving the bears may move the problem. Even after bears have been moved, they are likely to return to their original capture site. Bears that are relocated may transport diseases or parasites to other bear populations.

Silvicultural Practices

Bears are selective when choosing the areas where they forage and the trees they strip. Several trees within a stand may be stripped while adjacent trees are ignored or barely damaged. Bears select the healthiest, fastest growing trees. Damage occurs more frequently after certain silvicultural practices. Thinned stands tend to be more vulnerable than dense stands. Depredation also appears to increase after urea fertilizer has been applied.

A series of studies was conducted to assess whether bears selected trees to strip based on chemical constituents within a tree's vascular tissue and the impact of forest management practices on these constituents. Sugars and terpenes were correlated with the extent of damage inflicted on a tree. Generally, sugars are desirable to bears and terpenes are not. Sugars are concentrated in the vascular tissue of trees. Conifers have high concentrations of terpenes, compounds known to discourage animals from feeding on other plants. A summary of the test results include:

The amount of damage and the concentrations of sugars and terpenes are correlated. The ratio of sugars to terpenes tended to be higher in preferred trees than in trees that were not preferred or were rejected. Bears appear to forage in a way that maximizes sugars while minimizing terpenes.

Thinning significantly increased the concentration of sugars while having only a minor impact on terpene concentration. The net effect of thinning was an increase in the sugar-to-terpene ratio in the vascular tissue. These results help explain why bears are more likely to strip trees in thinned stands than in dense stands.

Fertilizing trees with urea increased tree diameter and sugars the year after application, but did not alter the terpenes. The increase in tree diameter and sugars was not apparent in later years. These data suggest that fertilizing will probably not increase the potential of bear damage for more than 1 year.

Pruning treatments significantly decreased the amount of vascular tissue and the sugar concentration without affecting the terpene concentration. Pruning decreased the sugar-to-terpene ratio. This suggests that bears would tend to avoid pruned trees. Bear preference for unpruned trees was demonstrated in a survey of bear damage on a 20-hectare Oregon Department of Forestry pruning test site. Statistical analysis revealed that unpruned Douglas-fir trees were four times more likely to be damaged than pruned trees. Similarly, unpruned western hemlock trees were three times more likely to be damaged than pruned trees.

The impact of selection of the fastest growing progeny on allocation of sugars and terpenes in a tree's vascular tissue also was investigated. Samples were collected from six known genetic families of Douglas-fir at five different progeny test sites. Chemical assays revealed that terpene concentration was not necessarily correlated with growth. Allocation of sugars in vascular tissues was subject to the interaction between the environment and genetics. These data suggest that it may be possible to select trees that are less palatable to bears without sacrificing growth potential.

Silvicultural practices affect chemical constituents found in trees. The extent to which altering practices to reduce bear damage depends largely on alternative foraging options. For example, a pruned stand located among unpruned stands may be less vulnerable to bear damage, but if all stands are pruned, the bears' options become limited to ingesting fewer carbohydrates or going hungry. Given this option animals generally do not select starvation. Greatest value of understanding the impacts of silvicultural practices may be predicting where and when bear damage is likely to occur and appropriately implementing management techniques.

Figure 3—A feeding station that dispenses pellets with a high concentration of sugar. When they had the opportunity, bears tended to feed on pellets rather than strip bark from trees.

Alternative Food Sources

Private timber managers began investigating alternative damage control techniques during the mid-1980s. In 1985, bears were provided an alternative food source to reduce tree girdling. During the first year, about 2,250 kilograms of pellets were fed to bears from 10 feeders. Since its inception, this program has continued to grow. During 2001, about 300 metric tons of pellets were offered from about 900 feeders across western Washington, and a few feeders in California and Oregon.

Feeding Stations—Most forest managers in western Washington use similar approaches when feeding bears. Feeding stations (figure 3) are constructed from 55-gallon (250-liter) metal or plastic drums. An opening in the front provides access to pellets. A simple self-feeding delivery system prevents bears from spilling pellets. A foam-insulated plywood roof keeps pellets dry. A single feeder holds about 90 kilograms of pellets. Commercial pellets are about 0.6 centimeter in diameter and 1.3 centimeters long. They resemble dry commercial dog food, but are greenish. The sugar concentration in pellets is high (about 20 percent) and provides at least four times the concentration of sugar found in the vascular tissue of Douglas-fir trees during the spring. The pellets include fats, proteins, vitamins, and minerals to provide the bears a nutritionally balanced diet. Feeders normally are placed near a road so they can be restocked easily, but away from public areas to avoid possible conflicts with people. All feeders are removed from the forest at the end of the feeding season, sometime during the middle of July. Bears normally wean themselves from feeders once alternative foods (such as berries) become available. When feeding stations are no longer being used, they are removed to reduce vandalism and the perception that feeders could serve as bait stations for persons hunting bears.

The supplemental feeding program appeared to be effective in reducing bear damage in particular timber stands. Bears generally girdle fewer trees after they start consuming pellets. However, limited empirical evidence was available to document these observations. In addition, the effect of supplemental feeding on bear behavior is largely unknown. Several studies were conducted to learn more about supplemental feeding and its effects. Summaries of the results of those studies follow.

Efficacy—Overall, supplemental feeding reduced damage to Douglas-fir trees. Damage in stands with supplemental feeders was just one-fifth the damage in stands without feeders during the first year pellets were offered to bears (table 1). In most feeding sites, damage was even less severe during the second year (table 2). Bears probably require time to locate feeders and begin using them.

Nutritional consequences—During the spring, bears living in areas with feeders gained more weight than bears in areas without feeders. By the fall, bears of the same age had the same weight whether they lived in areas with feeders or not. Therefore, feeding probably does not improve the reproductive fitness of bears. The study did not assess whether the program benefited lactating females.

Table 1—Douglas-fir trees damaged by black bears on seven 20-hectare timber stands with feeders and seven 20-hectare timber stands without feeders.

	Damage before feeders were installed		
	Damaged trees	**Undamaged trees**	**Total**
Stands with feeders	1,798	5,181	6,979
Stands without feeders	1,647	5,104	6,751

	Damage the first year after feeders were installed		
	Damaged trees	**Undamaged trees**	**Total**
Stands with feeders	35	5,002	5,037
Stands without feeders	187	4,861	5,048

Table 2—Douglas-fir trees damaged by black bears on seven 20-hectare timber stands with feeders and seven 20-hectare timber stands without feeders the second year after the feeders were installed.

	Damage the second year after feeders were installed	
Stand	**Damaged trees in stands with feeders**	**Damaged trees in stands without feeders**
A	55	33
B	2	33
C	2	22
D	5	21
E	4	3
F	2	24
G	2	15
Total	72	151

Table 3—Type and number of black bears monitored at feeders in western Washington during 1999 and in western Oregon and Washington during 2000.

	Black bears monitored at feeders during 1999 and 2000	
Type of bear	**1999**	**2000**
Females	4	12
Females with cubs	2	2
Cubs (sets)	2	2
Adult males	5	32
Subadult males	6	2
Yearlings	1	7
Total	20	57

However, the high-energy diet in areas with feeders may enhance a female bear's milk production, improving the chance her cubs will survive.

Behavioral consequences—Bear behavior around the feeders was monitored. All classes of bears fed at the stations (table 3). There was no indication that one class of bears (such as females) avoided feeders during times of high use more than another class of bears (such as large males). Most bears visited more than one feeder. Bears generally fed at feeders every 2 or 3 days. No bears were observed protecting feeders from intruders. Dominant bears may not restrict access to this resource because feeders provide an unlimited amount of food. Radio telemetry studies showed that the presence of feeders did not affect the size of a bear's home range.

The use of feeding stations requires a long-term commitment and should be continued until trees are old enough that the risk of damage is reduced. Some bears may not eat from the feeding stations and may continue to damage trees. Lethal control may have to be combined with feeding stations before damage is reduced to acceptable levels.

Alternative Approaches

When bears are damaging valuable trees, a manager needs to develop a damage management strategy that considers all feasible approaches to resolve the problem and selects the most appropriate approach for each situation. Many approaches other than supplemental feeding have been suggested by persons with little or no experience in protecting forest resources. Although most of these suggestions lack merit, they should be considered. Under some conditions, it might be feasible to adapt some aspects of them into a comprehensive management strategy.

Conditioned avoidance—Conditioned food avoidance occurs when a food is altered to produce gastrointestinal distress. Generally, animals are more likely to form aversions to novel foods than to known "safe" foods. Training animals to avoid safe foods requires repeatedly feeding them altered food that produces gastrointestinal distress. When bears peel trees, they are eating a known source of sugars when other sources are limited. Using conditioned aversion to train bears to avoid sapwood is impractical.

Fencing—Excluding animals from a site prevents them from causing damage. However, constructing and maintaining a fence that will keep bears out of forest stands would be costly, particularly in areas with steep terrain. Regardless of the cost, a fence would impede movements by other wildlife, pose a hazard to some species (such as deer), and require disturbing natural habitats during installation. Fencing can be used to protect small research plots or valuable genetic sources from bears, but fencing is not a practical approach to prevent damage at most sites.

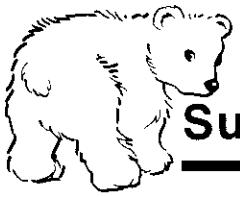
Birth control—Some persons have proposed managing black bear populations through contraceptives or chemical sterilants. If conception were prevented in enough females, local populations would decline over the long term. The efficacy of this approach and the ethical concerns associated with it remain controversial among biologists and the general public. Although this approach is occasionally promoted by some individuals or groups, no chemical or biological contraceptive agents are available for use in bears.

Devices to frighten bears—Devices traditionally used to frighten animals, such as propane cannons, sirens, lights, and scarecrows, are generally ineffective, even over the short term. The effect of these devices on bears has not been studied. Bears generally avoid human activity. Lights or noisemakers can deter bears, but bears will become accustomed (habituated) to these devices over time.

Devices activated by an animal's presence are generally more effective than permanent or routine displays. These devices will probably deter bears longer than devices that are active whether or not a bear is present. Installing devices on the scale needed to deter bears from a forest plantation would be costly because the entire plantation would have to be covered. Forest plantations provide habitats and resources for numerous wildlife species that would be harmed if the devices were truly effective. The ecological implications of treating thousands of forest hectares with sirens and lights would probably prevent their use. These devices are generally impractical, except to protect small, carefully selected areas.

Repellents—Repellents reduce the desirability of a food. Bears avoid apples treated with bittering agents. Several commercially available deer repellents contain bittering agents. A study assessing whether repellents could prevent bears from stripping trees was inconclusive, but results indicated that additional research was merited. If repellents are applied across a plantation, bears may have to choose between going hungry in the spring or eating a nutritious, but bitter, food. Bears might move to untreated areas. But the practicality and cost of treating thousands of trees each spring will probably prevent repellents from being used, except to protect small, carefully selected stands.

Alternative natural plants—Bears are believed to peel trees because other forage is limited or of poor quality. Bear damage occurs during the spring when most plants are dormant or are too small to provide much nutrition. Landowners can encourage plants that are available during the spring, such as skunk cabbage and devil's club. Salmon berry produces a berry crop earlier than most plants. Alternative plants should have sugar levels that are higher than tree sap to deter bears from stripping trees. These plants are unlikely to provide enough food to maintain bears throughout the spring. In addition, if these plants were encouraged near a vulnerable timber stand, they might attract bears to the stand.



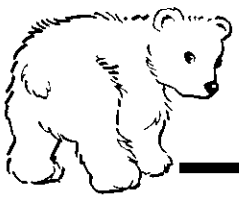
Summary

Managers should consider all options when developing a management plan to reduce damage caused by bears stripping trees in the spring. A combination of methods will probably be needed for animal damage managers to meet their objectives while maintaining viable wildlife populations. Removing bears can stop immediate problems and reduce problems over the long term. Fewer bears will peel fewer trees. Lower populations reduce competition for alternative foods.

Silvicultural practices can play a role in managing this problem. Delaying thinning or maintaining higher stocking rates may reduce the number of trees that bears strip. Pruning trees also appears to reduce damage. Stand improvements, such as thinning or fertilizing, increase the potential for damage. Altering silvicultural practices may encourage bears to feed elsewhere, but will not stop them from stripping trees.

Providing bears an alternative food may reduce damage to timber resources, but will not eliminate it. Even with supplemental feeding, extensive damage may occur on some sites. Other proposed approaches to reduce the number of trees stripped by bears are impractical for timber plantations.

Bear management that protects timber resources is often controversial. Managers need to consider economics and the ecological and social implications of any action before implementing management plans to reduce the damage caused by bears.



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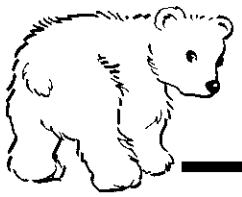

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Library Card

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Describes alternative approaches to controlling the damage black bears cause during the spring when they strip bark to eat the newly formed wood underneath. One bear might strip as many as 70 trees in a day. The trees will be damaged and may be killed if the bark is stripped all the way around the tree, girdling it. Bears appear to strip the most vigorous trees, preferring stands that have been thinned, or those where urea fertilizer has been applied. Bears also appear to prefer trees with a high concentration of sugars relative to the concentration of terpenes. Pruning decreases the sugar-to-terpene ratio, reducing the likelihood that trees will be stripped by bears. Bears generally quit stripping trees once other foods become available during the late spring or early summer. One approach to reducing damage has been to provide supplemental feed (pellets resembling dog food) in stands being damaged by bears. In one study, damage was just one-fifth as much in stands with feeders as in stands without feeders. Killing bears in areas where trees are being stripped can also reduce damage. Other approaches, such as relocation, contraception or sterilization, or repellents, are not generally practical for protecting forest plantations.

Keywords: animal damage control, carbohydrates, fertilization, girdling, plantations, reforestation, repellents, silviculture, sugars, terpenes, thinning, *Ursus americanus*

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